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ABSTRACT

A new methodology for the mathematics classroom involving finger calculation received widespread publicity during 1978. The Texas Education Agency decided to take a systematic look at the impact of this method so that public school educators would have data on which future decisions concerning its use could be made. The description of the study details teacher training, selection of classrooms, evaluation instruments, and data collection. Pretest, posttest, and adjusted posttest data are presented for grades 1, 2, 3, and remedial 5. In addition, results of a teacher questionnaire are included. (MK)

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Use of Finger Calculation in the Elementary Classroom

ED184853

Texas Education Agency

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Mathematics Section
Division of Curriculum Development
Texas Education Agency
1980

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FOREWORD

This report contains a description and the results of a study project conducted in Texas regarding the use of a method of finger calculation in Grade 1, 2, 3, and remedial 5 classrooms. The information provided can be useful to district administrators who are in the process of making decisions regarding the use of this method to teach concept development and computational skills to elementary mathematics students. The results of the study are being reported so that future actions can be taken on an informed basis.

Alton O. Bowen
Commissioner of Education

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INTRODUCTION

A new methodology for the mathematics classroom involving finger calculation received widespread publicity during 1978. The Texas Education Agency decided to take a systematic look at the impact of this method so that public school educators would have data on which future decisions concerning its use could be made. Education service center personnel were involved, and a plan for the study was developed in summer 1978. The plan included:

- the formation of four consortia consisting of from four to six service centers each
- the training of teachers at the elementary level
- the selection of experimental and control classrooms
- the distribution of materials to the experimental classrooms
- the pre- and posttesting of students in experimental and control settings

The purpose of the project was to carefully study the use of the finger calculation method in the elementary school before an extensive move toward its implementation was made statewide.

The study was not designed to yield results that are generalizable to the state. As a whole, the data and findings can be most useful when viewed as a large case study. Data and related findings are available for Grades 1, 2, 3, and remedial 5.

DESCRIPTION OF STUDY

Initial Training

During Summer 1978, Texas education service centers, under the direction of the Texas Education Agency, implemented a plan of action to provide a cadre of trained personnel to train others in local school districts in a finger calculation method. A group of approximately 160 teachers, supervisors, and administrators from Texas schools was given 30 hours of training in the method of finger calculation. The training was administered through an organization of the education service centers into four consortia as follows:

- Consortium A—Regions VII, VIII, IX, X, and XI
- Consortium B—Regions I, II, III, and XX
- Consortium C—Regions XIV, XV, XVI, XVII, XVIII, and XIX
- Consortium D—Regions IV, V, VI, XII, and XIII

One-week training sessions were held from June 26, 1978 through July 28, 1978, with two-day followup sessions in September. The one-week training sessions were conducted by personnel from Chisanbop Enterprises, Inc., and workshop materials were provided by that corporation. The two-day followup sessions were conducted by personnel from Fingermath International. Materials used for the follow-up sessions and for the experimental classrooms were produced by Fingermath International, McGraw-Hill Book Company.

During the training sessions, two points were emphasized regarding the finger calculation teaching method. First, teachers who use the method must have a solid understanding of how the method works and in what situations the method can best be used. Second, teachers using the method must realize that this instructional approach will not solve all the instructional difficulties of mathematics, and it does not constitute a total mathematics program.

Selection of Classrooms

A plan was designed to gather evaluative information on the classroom effectiveness of the finger calculation method. The plan specified that three districts would be selected within each consortium to pilot the program in their schools. There was to be a total of 12 teachers using the method in Grades 1, 2, 3, and remedial 5 in each consortium. Remedial Grade 5 classes were defined as classes in which students had been pulled from their regular fifth grade mathematics programs and were receiving approximately 45 minutes of instruction per day in mathematics at least one and one-half years below grade level expectation. Table 1 illustrates the projected breakdown of teachers by grade and consortium.

Table 1

NUMBER OF TEACHERS PROJECTED TO TEACH FINGER CALCULATING

Grade	Consortium A	B	C	D	Total Teachers
1	3	3	3	3	12
2	3	3	3	3	12
3	3	3	3	3	12
Rem. 5	3	3	3	3	12

Twelve teachers from comparable classroom situations were to be selected from each consortium as a control. Table 2 shows the numbers of teachers that were projected to teach the experimental (or finger calculation) group and the control group in each grade level.

Table 2

NUMBER OF TEACHERS PROJECTED TO TEACH EXPERIMENTAL AND CONTROL GROUPS

Grade	Total Teachers Projected Experimental	Total Teachers Projected Control
1	12	12
2	12	12
3	12	12
Rem. 5	12	12

After the training took place and the evaluation project was begun, some consortia were unable to secure teachers as specified in the plan. Hence the actual number of teachers participating in the evaluation project differed from the projected totals in table 2. Random selection of classes or students was not used. Table 3 gives the actual numbers of teachers who participated in the evaluation project.

Table 3

ACTUAL NUMBER OF TEACHERS IN THE EVALUATION PROJECT

Grade	Total Teachers Experimental	Total Teachers Control
1	11	8
2	11	15
3	10	18
Rem. 5	14	11

Evaluation Instruments

Project evaluation instruments were developed by a committee of curriculum and evaluation experts composed of ESC and LEA representatives from each consortium and TEA staff. The goal of the committee was to develop an instrument for each of Grades 1, 2, 3, and remedial 5 that would measure skills and concepts appropriate for the expectations of the mathematics curriculum at each level. The instruments were designed to measure accuracy and understanding but not speed.

The evaluation committee carefully selected objectives for each instrument. The objectives selected were not chosen to measure the calculation method specifically, but were thought to be objectives for which the method might have some impact. Following the development of objectives, items were selected from banks of validated items, and consumable test booklets were developed for each grade level. Due to the time constraints of the project, the completed instruments were not field tested, and no measure of validity or reliability was obtained.

Data Collected

Pretest data were collected in all classrooms in the pilot for the purpose of testing the comparability of the two groups. Pretests were given from late September to mid October 1978, just prior to the initiation of the teaching of finger calculation in the classroom. Not all classes started the project at the same time. The teachers of the classes participating in the experimental group were asked to teach finger calculation 10 minutes per day, four days per week. The instruction in finger calculation was to be done during the time scheduled for mathematics. Approximately 40 minutes per day were to be given to class time for teaching mathematics.

Posttest data were collected by each experimental classroom teacher after 15 weeks of using the method in the classroom (60 days of instruction resulting in a total of 10 hours). Posttest data were collected in the control classes after 15 weeks of instruction. Additional data were collected from teachers in the experimental group regarding their opinions on how the finger calculation method affected student motivation, study habits, and time spent on mathematics. Teachers were also asked about parent and administrator reaction and what they thought were the strengths and weaknesses of the method.

FINDINGS

The study was designed to compare differences in student performance between the experimental and control groups at posttest time. Rather than assume complete comparability between experimental and control groups, a pretest was given to all participants. Table 4 shows the size of the groups and the differences in performance of the groups. The groups are assumed to have been comparable for the purposes of the study, due to the slight differences in pretest mean scores.

Table 4

PRETEST MEANS AND GROUP SIZE BY GRADE LEVEL

Grade Level	Experimental Group		Control Group		Difference in Means
	Mean	N	Mean	N	
1	17.3	177	17.3	124	0
2	24.5	235	24.7	189	0.2
3	24.7	244	25.8	201	1.1
Rem. 5	13.1	184	12.1	145	1.0

The data were analyzed using analysis of covariance, with pretest scores as covariates. Analysis was done using the Statistical Package for Social Sciences (SPSS) analysis of variance. Computer printouts of the analysis are on file at the Texas Education Agency, and interested persons may review these data if desired. However, for purposes of this report only means are given, with differences noted that were found to be statistically significant. (Significance levels assume a random selection design.)

In the process of matching the pretest and posttest scores, many students' records had to be discarded because of insufficient matching identification information. This problem reduced substantially the number of students analyzed in each grade.

In tables 5 and 6, means were adjusted statistically according to pretest scores and independent instructional variables, including years experience, number of mathematics hours in college, and classroom teaching environment. Because Grade 1 students had only a total pretest score, that mean was used to adjust all categories of the posttest scores (concept, addition, subtraction, and total scores). Grade 2 students were not tested for multiplication skills on the pretest. Therefore, the total pretest score was used to adjust the posttest multiplication mean at this grade. All categories of the posttest scores from Grades 3 and remedial 5 were adjusted by the corresponding category score on the pretest.

Classroom teachers were directed to give approximately 10 hours of instruction in finger calculation over a period of 60 days. Monitoring did not take place; therefore, comparable treatment is assumed.

Tables 5 and 6 present a comparison by grade of the experimental group mean and the control group mean after instruction in finger calculation, along with means statistically adjusted for pretest scores and independent factors. Note that the number of students in groups (N) is less than those shown in table 4, due to the discarding of student data for which pretests and posttests could not be matched and for which independent factor data were missing.

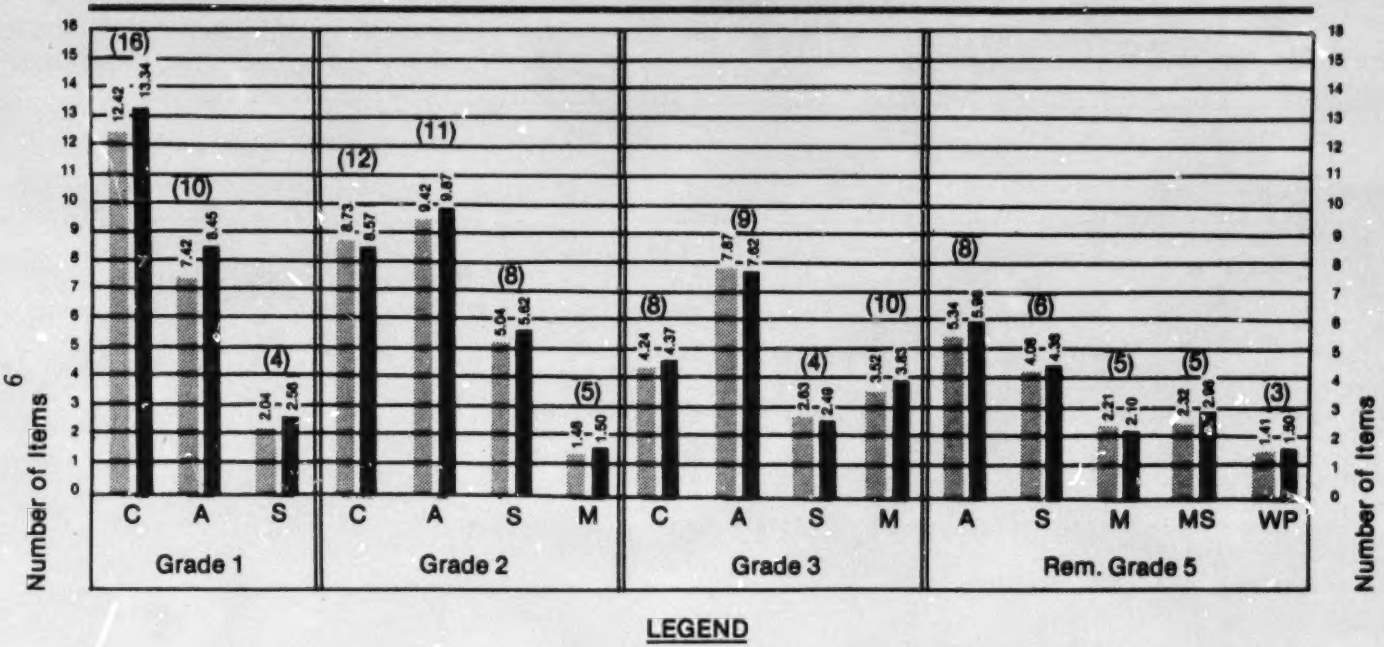
Table 5

GROUP POSTTEST MEANS

	Score	Number of Items	Control N	Exper. N	Unadjusted Mean Scores		Mean Adjusted for Pretest Score and Independent Factors		Exper. Group Adjusted Mean Minus Control Group Adjusted Mean
					Control Group	Exper. Group	Control Group	Exper. Group	
GRADE 1	Total	30	90	155	22.31	24.10	21.86	24.36	2.47*
	Concept	16	90	155	12.67	13.19	12.42	13.34	0.92*
	Addition	10	90	155	7.58	8.38	7.42	8.45	1.03*
	Subtraction	4	90	155	2.08	2.54	2.04	2.56	0.52*
GRADE 2	Total	36	183	203	24.09	26.09	24.75	25.56	0.81
	Concept	12	183	203	8.56	8.71	8.73	8.57	-0.16
	Addition	11	183	203	9.29	9.88	9.42	9.87	0.45*
	Subtraction	8	182	202	4.92	5.71	5.04	5.62	0.58
	Multiplication	5	182	202	1.29	1.65	1.48	1.50	0.02
GRADE 3	Total	31	152	138	19.14	17.31	18.04	18.52	0.48
	Concept	8	152	138	4.50	4.08	4.24	4.37	0.13
	Addition	9	152	138	7.90	7.59	7.87	7.62	-0.25
	Subtraction	4	152	138	2.70	2.41	2.63	2.49	-0.14
	Multiplication	10	152	138	4.06	3.24	3.52	3.83	0.31
REM. GRADE 5	Total	27	63	109	14.72	17.23	15.44	16.81	1.37
	Addition	8	63	109	5.28	5.99	5.34	5.96	0.62
	Subtraction	6	62	109	3.82	4.52	4.08	4.38	0.30
	Multiplication	5	63	109	1.94	2.26	2.21	2.10	-0.11
	Math Sentences	5	63	109	2.37	2.94	2.32	2.96	0.64*
	Word Problems	3	63	109	1.37	1.53	1.41	1.50	0.09

*Significant at the .05 level. (Significance levels assume a random selection design.)

Table 6
ADJUSTED POSTTEST MEANS



LEGEND

C—Concept Score
A—Adding Score
S—Subtracting Score
M—Multiplying Score
MS—Math Sentences Score
WP—Word Problem Score
—Control Group Mean
—Experimental Group Mean
(N)—Number of items measuring objectives

TEACHER QUESTIONNAIRE

Teachers in the study who taught finger calculation were asked to complete a questionnaire concerning student attitudes, study habits, time spent on mathematics, parent and administrator reaction, strengths of the method, and weaknesses of the method. Thirty-four responses were completed. Each question is stated below, followed by a summary of the responses given.

1. Does the use of this method of calculation with students seem to affect their attitude or motivation toward mathematics? If so, in what way?

Twenty-seven teachers indicated that attitude seemed to be positively affected, while two indicated attitude was negatively affected. Five teachers did not respond.

The evidences of positive motivation cited were:

- Interest level increased with the method.
- The method gave students a feeling of success.
- Students had no fear of failure.
- There was better class attendance and participation.
- Students wanted to stay when class was over.
- Students were eager to participate.
- Students asked to use the method.
- Students had fun with the method.
- Students had better concentration with this method.
- Some students practiced on their own.
- Students were more confident with the method.

The evidences of negative motivation cited were:

- Poor response was received from low-achievers.
- Initially, there was a great deal of motivation, though this enthusiasm seemed to wane after a few weeks.

2. Does the use of this method of calculation with students seem to affect their study habits in mathematics? If so, in what way?

Eighteen teachers indicted that study habits were affected, while 15 indicted that study habits were not affected. One teacher did not respond.

Comments under "yes" responses were:

- Students asked for more homework problems.
- Students spent more time studying addition.
- Students wanted to take their papers home.
- The method helped students who still needed concrete or semiconcrete aids.
- Students worked on the method just for fun.
- Students seemed to accept mathematics as more of a challenge.
- Students rechecked answers with the method.
- Many students started other problem sets without being told.

Comments under "no" responses were:

- There seemed to be no difference in study habits.
- Students did not memorize facts needed for timed tests.

- The Grade 5 students had a hard time integrating the method into their regular study habits.

3. Did your students spend more "in school" time on mathematics as a result of using this method of calculation. If so, approximately how much more?

Comments under "yes" reponses were:

- My stronger math students spent approximately 5 percent more time.
- Approximately 20-30 minutes more were spent per day.
- We spent about about 10-15 minutes more per week.
- Students in the experimental group spent 10 minutes more per day.
- Students have carried the method over into their other work on their own.
- They did practice during the day (5-10 minutes).
- It carried over to their other mathematics activities.
- Most of them spent approximately 15 minutes more.

Comments under "no" responses were:

- School time on mathematics is 45 minutes, regardless of what math we are doing.
- The time allowance for math is definite.

4. What comments have you had from parents of students receiving instruction in this method of calculation? What comments have you had from administrators or other audiences?

Twenty-nine teachers indicated that they had positive comments, while one teacher indicated a negative response. Four teachers indicted no comments were received.

Positive comments were:

- Parents have been enthusiastic.
- Parents have indicated a desire to purchase materials.
- Many parents have inquired about private lessons.
- Parents were pleased and happy because they had seen their children using the method at home.
- Parents are impressed with the method.
- Parents are just as excited as the students.
- The parents are pleased with the accuracy and speed that the children display when they are working problems.
- Both parents and administrators have been amazed—and very proud of the students' progress.
- The parents are overwhelmed that their first graders can do addition with carrying, subtraction with borrowing, and multiplication.
- Parents have indicated that the children enjoy math more this year and are interested in math at home.
- Parents want their children to teach them.
- The most frequent comment I heard was how enthusiastic the children were about the program and how much they looked forward to the instruction.

Negative comments were:

- Some parents were unhappy that they could not help their children at home.

- Some teachers not using the method were concerned about children using their fingers to count.

5. In your opinion, what are the strengths of this method of calculation?

Comments about strengths were:

- The method aids in student understanding of counting, with instant reinforcement.

- Addition and multiplication are easily understood.

- The method increases computational skills, speeds calculation, and increases accuracy among pupils who do not know their math facts.

- Some students can be successful in mathematics using this method, when they would not be using other methods.

- The children are using manipulatives (their fingers) to learn basic math concepts.

- Students can actually see how mathematical operations work (such as multiplication as repeated addition).

- The method can be an excellent reinforcement for studying place value.

- The method is a concrete way of teaching tens and ones.

- It is a fun method of computation.

- Your fingers are always with you.

- The method is motivational and students demonstrate better accuracy.
- The concentration required by the method is a great strength.
- It is definitely a help in column addition.
- Students have the benefit of something concrete—their fingers—to solve math problems.
- It is a challenge for better students.
- The method teaches a child to appreciate his or her own abilities. Self-satisfaction occurs as the child accomplishes that which he or she previously has found so difficult.
- Slower students can do more and really feel good about themselves.
- When doing problems with carrying, students readily see which number is to be carried.
- It can give a child knowledge in place value, combining sets, taking sets apart, greater than, and less than.
- Instead of being left with paperwork, the oral exercises allow direct teacher involvement.
- The method provides support to the student's mental calculation and builds confidence.
- The method strengthens and develops children's basic understanding of the structure of mathematics.
- It drills basic math skills and facts so much, that children begin to learn them.
- Its simplicity is its greatest strength.

- The method seemed to increase students' attention span.

6. In your opinion, what are the weaknesses of this method of computation?

Comments about weaknesses were:

- Students rely heavily on counting out the answer, even if they already know it.
- It is confusing for students to try to learn math by this method and by the conventional method at the same time.
- It is more time consuming for those good in mental computation.
- The method takes more class instructional time and needs continued practice to keep the enthusiasm going.
- Students do not learn facts, but depend on fingers.
- It is time consuming due to the fact that so much practice is required.
- It is somewhat difficult to teach 28 children and give individual help.
- New students have a hard time catching on.
- Slower students had difficulty changing hands and going from ones to tens.
- I found the children were easily confused in multiplication, and subtraction really was not very useful.
- Children seemed to tire of the method after three or four months.
- The biggest weakness that I have noticed has been in subtraction and division.

- The children have trouble remembering numbers over 100.
- Students have difficulty remembering which number they are on when adding a column of numbers.

SUMMARY

This report provides information and results from a study in which the finger calculation method was taught in selected Grade 1, 2, 3, and remedial 5 classrooms across Texas. Care should be taken in making generalizations from the results, because many variables were not controlled for in the study. However, the information provided may be used by administrators as they make decisions about the use of finger calculation with elementary mathematics students.

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;
(2) operation of school bus routes or runs on a non-segregated basis;
(3) nondiscrimination in extracurricular activities and the use of school facilities;
(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;
(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;
(6) nondiscriminatory practices relating to the use of a student's first language; and
(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

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